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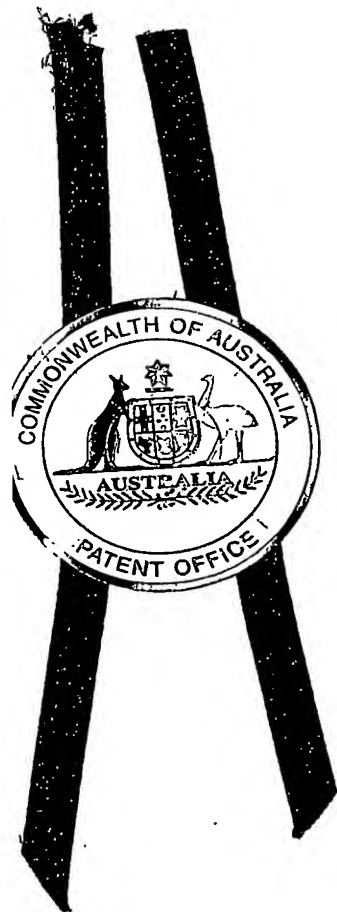
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I, LEANNE MYNOTT, MANAGER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2002952811 for a patent by OXYGEN THERAPY INTERNATIONAL PTY LTD as filed on 22 November 2002.



WITNESS my hand this
Twenty-eighth day of November 2003

LEANNE MYNOTT
MANAGER EXAMINATION SUPPORT
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AUSTRALIA

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PROVISIONAL PATENT SPECIFICATION

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INVENTION TITLE: Hyperbaric Therapy Capsule

The invention is described in the following statement:-

TITLE: HYPERBARIC THERAPY CAPSULE

TECHNICAL FIELD

5 This invention relates to a chamber suitable for use by a person for hyperbaric oxygenation for therapy, prophylaxis or general health improvement. It is particularly, though not exclusively, concerned with a hyperbaric capsule suitable for use by one person at home, or for use by a clinic for the treatment individual clients. The capsule may be used with or without oxygen enrichment of air breathed by the user.

10

 This invention also relates to methods for operating such capsules to ensure efficacy and safety.

BACKGROUND TO THE INVENTION

15 Hyperbaric chambers known in the art are commonly designed for the recompression of divers to mitigate gas embolism, the treatment of patients in a hospital or clinic environment and for diver or athlete training. In much of the art known to the applicant, hyperbaric chambers are massive and complex devices that require expert attendant staff. Such chambers are therefore not suited for
20 home use by individuals without attendants. Moreover, since expert staff will be in attendance while the hyperbaric chambers of the art are in use, no provision is made for the user or patient to open the chamber from within so that he or she can exit without assistance.

25 In many hyperbaric chambers for use in the clinical environment the patient is required to lie prone in a tube. Indeed, it is important in recompression chambers for the patient to be prone and inclined head-down at an angle of about 30 degrees. This results in the massive construction typical of many such chambers. [See, for example, US patents 4, 727,870 to Krasel, 5,433,334 to Reneau and
30 6,354,457 to Aaron, and US design patents 346,864 to Reneau and 415,278 to Bowman.] However, it is also important that recompression chambers be capable of being transported to a diver with the bends and rapidly deployed on site. Relatively compact chambers suitable for transport by truck or plane are therefore known in the art. [See, for example, US patents 4,811,729 to Sands et al,

5,378,093 to Santi and 6,321,746 to Schneider. For relatively modest recompression pressures, portable inflatable chambers with flexible walls are also known in the art. [See, for example, the above US patents to Santi and Schneider as well as US patents 5,109,837 and 5,398,678 and to Gamow, 5255,673 to Cardwell and 5,360,001 to Brill.]

The traditional design of a hyperbaric chamber for use in hospitals and clinics is a cylinder with a round door at one end through which the patient can be introduced in the prone position. Such a design appears to have been dictated by the need to minimize the area of the end door so that the force on the door is modest even when the chamber is fully pressurized. Nevertheless, many such chambers have the appearance and claustrophobic feel of totally enveloping 'iron lungs' that prevent the patient from moving significantly – let alone sitting up – and that allow visual contact with the operators through small portholes. [See, for example, US patent to Krasel above.] The fact that there is generally no way that the user can open the chamber from within exacerbates the natural claustrophobic anxiety associated with enclosure in such a confined space.

Nevertheless, the prior art does disclose designs for hyperbaric chambers that permit the patient to be seated. US patent 5,327,904 to Hannum and US patent 6,352,078 to Harvey disclose short cylindrical chambers of sufficient diameter to accommodate a seated person. In the former case a flat door is fitted into the cylindrical shell and in the latter case the door is set into one end. In both cases, however, the doors open inwards (to enhance strength and facilitate sealing under pressure). Since the open door must allow the user entry and, after entry, clear the seated user as it is being closed, the size of the chamber still needs to be substantial. Hannum nevertheless notes that an important feature of his chamber is that can be made sufficiently compact to fit through double (hospital) doors. Again, both chambers require the attendance of a skilled operator throughout the treatment of the patient or user, including the opening of the door to permit entry and egress at the start and end of the procedure. Thus neither chamber is suited to home use, for installation in a normal house or for use by a person without assistance.

Finally, it is to be noted that US patent 4,509,513 to Lasley discloses a 'hyperbaric chamber' that appears to be suitable for home use by a person without assistance. However, the device is a bag into which the user climbs like a pair of angler's waders, securing the opening around the upper part of the body (below the shoulders and not including the arms) to form a seal. The bag is then inflated with oxygen-enriched air. Obviously this device is not, in fact, a hyperbaric chamber in the normal sense – that is, one intended for pulmonary oxygenation.

OUTLINE OF THE INVENTION

From one aspect, this invention comprises a hyperbaric capsule including a base having a chair for the user, a removable transparent canopy adapted to fit onto the base in an substantially air-tight manner over a seated user and latching means for securing the canopy to the base at a plurality of points about its periphery. Actuator means may be provided for actuating the latching means to effect the latching and unlatching of the canopy to the base by a person seated within the capsule and/or by a person external to the capsule.

The chair will normally comprise a back adapted to support the back of the user at a comfortable angle to the vertical and a seat adapted to support the buttocks of the user at a comfortable angle to the horizontal. The base of the capsule preferably includes a floor in front of and below the chair seat adapted to support and accommodate the feet of a seated user. The base, the floor and the seat and back of the chair are preferably moulded integrally from fiber-reinforced plastics material so as to withstand the operating pressure of the capsule. The seal line between the base and the canopy preferably comprises a generally vertical inverted-U portion surrounding the back of the chair and a generally horizontal U-portion surrounding the floor and the seat of the chair.

Preferably, the latch means includes multiple movable latches arranged around exterior of the seal line of the base, each latch being adapted to engage a corresponding latch pin (or like coacting member) affixed near the seal line of the canopy. This allows the periphery of the canopy to lie outside the seal line of the base but inside the latches, so that the latches may assist in resisting lateral movement of the canopy periphery under pressure. Each latch preferably

operates in an over-center manner so that force tending to drive the canopy upwards and away from the base will tend to ensure that the latch is more forcefully closed. In this way, another optional feature of the invention can be provided; namely, that operation of the actuator means to release the catches
5 while there is pressure in the capsule will be rendered difficult or practically impossible.

To doubly ensure that the canopy cannot be flung open forcefully by premature release of the latch means, a pressure-operated interlock may be fitted to prevent
10 operation of the actuator as long as pressure within the capsule is greater than that outside. Preferably, this interlock is located within the capsule and can be moved manually by a person in the capsule in the event of malfunction thereof.

The canopy is preferably of a dished oval shape that (when closed) it
15 encompasses the base from the floor area to the top of the chair back. It can be formed from a thick sheet of highly transparent thermoplastic material by applying heat and pressure – a without the need for a mould – to generate the desired shape. Since the canopy can extend from the head to the feet of a seated user, and to each side of his or her legs, there is little sense of claustrophobia. An
20 edging of fiber-reinforced plastic material can be applied to the periphery of the canopy to form the canopy seal line and to mount the latch pins and other fittings (such as hinges and gas struts).

The canopy is preferably hingedly attached to the base at the front of the foot area
25 so that it can pivot forwards to allow ready ingress and egress of the user. The canopy may be supported in the open or partially open position by the use of gas struts or the like located at the front of the canopy on each side near of the floor. A flexible rubber-like sealing ring can be readily fitted to the periphery of the canopy and/or that of the base to ensure a substantially hermetic seal therebetween,
30 when the canopy is enclosed.

It will be appreciated that a capsule of the type described can be readily made to be small enough to fit through the standard doorways of a normal domestic dwelling and to be handled by one or two installers, particularly if the base is

provided with wheels. However, because of its small size and volume, it is desirable that there be adequate provision for heat and CO₂ removal. This may be achieved by ensuring sufficient of pressurized air through the capsule while it is in use. Preferably, the pressurized air is conditioned to user-controlled temperature and humidity. Additionally, heat-exchanger means may be provided to cool the base or chair of the capsule.

If oxygen supplementation is required, it will generally be most economical for the user to employ an oxygen mask while sitting in the capsule. Alternatively, the input air to the capsule can be enriched with oxygen.

With single-person use in mind, it is desirable that pressure, temperature and air/O₂ flow controls and/or indicators are located conveniently within the capsule, preferably on the base thereof or on a lower portion of the canopy. Various audible and/or visual alarms may also desirable; for example, a power-failure alarm, an excess temperature alarm, and an excess CO₂ alarm. Preferably, these indicator, controls and alarms are duplicated on the exterior of the capsule. The activation of any of the alarms may be arranged to automatically depressurize the capsule and even to operate the actuator to release and 'pop' the canopy. A standby pressure vessel or electric battery may be needed to effect such functions despite a mains power failure.

DESCRIPTION OF EXAMPLES

Having portrayed the nature of the present invention, a particular example will now be described with reference to the accompanying drawings. However, those skilled in the art will appreciate that many variations and modifications can be made to the example, and many other examples can be devised, without departing from the scope of the invention as outlined above. In the accompanying drawings:

Figure 1 is a perspective view of the capsule of the chosen example with the canopy closed and a user seating inside.

Figure 2 is a perspective view of the capsule of Figure 1 with the canopy open and no user visible.

Figure 3 is a longitudinal cross-section of the closed capsule of Figure 1, the user not being shown.

Figure 4A is a perspective view of the underside of the base showing the manner in which the multiple latches are operated in unison.

Figure 4B is a side elevation of the frames of the canopy and the base with the canopy frame in the open position.

Figure 4C is a side elevation of the canopy and base frames with the canopy frame shown in the closed and latched position.

Figure 5A is an enlarged detail of one catch attached to the base with the coacting pin of the canopy frame disengaged.

Figure 5B is a similar view to that of Figure 4B showing the coacting pin of the canopy frame engaged with the latch of the base frame.

Figure 6A is a sectional detail of the hermetic seal with the canopy and base frames about to be engaged and the seal inoperative.

Figure 6B is a sectional detail similar to that of Figure 6A with the canopy and base frame engaged and the seal operative.

Figure 7 is a sectional detail through the base and the actuator handle showing the manner in which the internal and external handles are connected.

Figure 8 is a diagrammatic side sectional elevation of the closed capsule showing the arrangement of the air supply system, controls, alarms and auxiliary equipment suitable for use with the chosen example.

5 Figure 9A is a sectional detail of a safety interlock in the unguarded position and Figure 9B is a sectional detail of the interlock in the guarded position.

10 Figure 10A is a side elevation of the canopy and base frames in the open position showing a first alternative latching arrangement, while Figure 10B is a similar view to that of Figure 10A with the canopy and base frames in the closed position.

15 Figure 11A is a side elevation of the canopy and base frames in the closed position showing detail of a second alternative latching arrangement, while Figure 11B is a similar view to that of Figure 11A with the canopy and base frames in the open position.

20 Turning to Figures 1, 2 and 3, the basic components of the capsule 10 of the chosen example include a base 12, a chair 14 fitted into the base and a curved, sloping canopy 16, which includes a large transparent frontal window 18 and attached triangular side panels 20 at the bottom on each side. Canopy 16 is pivotally attached at the lower front to the front of base 12 by a hinge assembly 22 and, on either side near hinge 22, by gas struts 24 that regulate and control the
25 opening of the canopy. In Figures 1 and 3, canopy 16 is shown closed, while in Figure 2, it is shown open. The outline of a person 26 seated on chair 14 is indicated in Figure 1, but not in Figures 2 and 3.

30 In this description it will be convenient to refer to the pressurized space enclosed by canopy 16 and base 12 as the hyperbaric chamber and to refer to the entire device as the capsule.

As best seen from Figure 2, base 12 has a generally horizontal bottom 28 with a curved front 30 and a generally upright back 32 with a curved top 34. The upper

periphery 36 of the bottom 28 of base 12 is generally horizontal and of a U-shape, while the front periphery 38 of upright back 30 is generally upright and also of a U-shape. The rear of horizontal periphery 32 joins the bottom of upright periphery 34 at an angle 40, which corresponds to angle 42 of sides 20 of canopy 16. A
5 resilient seal-strip 44 runs around both U-shape peripheries 36 and 38 (Figure 2). The arrangement is such that, when canopy 16 is lowered onto base 12 to the closed position (as in Figure 1), its inner periphery – including the insides edges of sides 20 – comes to rest outside seal-strip 40 but in close juxtaposition or contact therewith all the way around. Thus, internal pressure in capsule 10 will press seal-
10 strip 44 outwards and into sealing contact with the whole periphery of canopy 16.

After being lowered to its closed position, canopy 16 can be secured to base 12 by pivoting side latches 50a, 50b and 50c on each side of base 12 to engage corresponding latch pins 52a – 52c each side of canopy 16. A pair of pivoting top
15 latches 50d engage a common latch pin 52d located inside the top rear of canopy 16. Latches 50 are mechanically linked (in a manner to be described) so as to operate in unison, latch 50c being formed on the lower end of an external actuator or handle 54, handle 54 also being secured to a shaft 84c (to be further
described) that passes through the wall of base 12 and is connected to an internal
20 handle 56. Thus, latches 50 can be operated by person 26 seated in the capsule using handle 56 or by a person outside the capsule using handle 54.

Canopy 16 comprises a curved fiber-reinforced plastic [FRP] skirt 60 moulded onto and around the periphery of a thick transparent plastic window 18, securely
25 joining triangular side panels 20 to window 18. The upper surface of base 12 is also moulded from FRP, to form the back 62 and seat 64 of chair 14 and a foot well 66. Chair 14 is completed by a back cushion 68 on back 62 and a seat cushion 70 on seat base 64. The upper surface of base 12 is moulded so that it extends outside seal-strip 44 and provides a socket or shoulder to locate the strip.
30 Thus, closure of the canopy 16 onto the upper part of base 12 forms a hermetically sealed enclosure, except for inlet slots 72 for the pressurized air and a pressure-regulating outlet valve 74 near foot well 66. A pair of wheels 76 are provided to assist movement of capsule 10 and a pair of screw-down feet 78 and

a pair of front pedestals are provided to stabilize the capsule once it is in position (Figure 3).

5 The latching mechanism will now be described in more detail with reference to the various parts of Figures 4 and 5, which illustrate the engaging peripheries of base 12 and canopy 16 with most other parts removed. The peripheral edge of base 12 is formed by a metal edge frame 80 that carries latches 50 and half of hinge 22. Similarly, the complementary peripheral edge of canopy 16 is a metal frame 82 that carries latch pins 52 and the other half of hinge 22. Frames 80 and 82 are
10 shown in the position for a half-open canopy in Figure 4A and in the position for a closed canopy in the rear perspective of Figure 4B and the side elevation of Figure 4C.

It will be seen (especially from Figure 4B) that catches 50a on each side of the
15 base frame are mounted on the ends of a common transverse shaft 84a, that catches 50b and 50c are similarly mounted on shafts 84b and 84c respectively. Short cranks 86a, 86b and 86c are fixed to the centers of shafts 84a, 84b and 84c (respectively), the free end of crank 86a being pivotally attached to a horizontal actuator rod 88 under the seat of the chair and the free ends of cranks 86b and
20 86c being pivotally attached to a common generally vertical actuator rod 90 behind the back of the chair. Rear end of rod 88 is pivotally linked to lower end of rod 90 by a bell-crank 92 that is mounted for pivotal movement on a transverse shaft 94 (Figure 4B), while the upper extremity 96 of rod 90 is attached to latch 50d. This arrangement ensures that all latches 50 will operate in unison. As
25 previously indicated, latches 50 are operated either by use external actuator handle 54 or internal handle 56, both of which are attached to shaft 84c. The inner handle 56 that is secured to shaft 84c via a bearing tube 98 (Figure 4B) that ensures a hermetic seal for the internal handle.

30 The operation of an individual latch – 50a – is illustrated in the detail views of Figure 5. Figure 5A shows frame 82 of canopy 16 resting on frame 80 of base 12 as it would appear when the canopy is closed. Latch 50a is a front-facing hook that is fixed to shaft 84a and engages latch pin 52a, latch 50a being moved into latching position by a rearward pull on actuator rod 88 that acts through crank 86a

fixed to shaft 84a to rotate shaft 84a and latch 50a counterclockwise. Figure 5B shows frame 82 of canopy 16 slightly removed from frame 80 of base 12. Latch 50a has been moved in a clockwise position by forward movement of rod 88 acting through crank 86a and shaft 84a to disengage pin 52a. Preferably, the geometry of latches 50 is such that an opening force on the latch pins (while the latches are engaged) will tend to maintain the latches in their closed positions. For example, the shape of the latch hook may be slightly re-entrant so that an opening force on the canopy will not tend to rotate the latches.

The enlarged diagrammatic sectional drawings of Figures 6A and 6B illustrate in more detail the structure of the base and canopy frames 80 and 82, and, the operation of seal-strip 44. Canopy 16 is preferably of sandwich construction having outer and inner sides 16a and 16b of FRP bonded to a foam core 16c. Canopy edge frame 82 is conveniently a tubular rectangular steel section that is bonded to FRP sides 16a and 16b. Base edge frame 80 is also conveniently a tubular rectangular steel section that is similar to the canopy edge frame and is bonded to the FRP moulding that forms base 12. However, an upstanding steel edge strip 80a is welded around the outside of base frame 80 so as to locate canopy frame 82, when canopy 16 is closed. Edge strip 80a thus serves to resist lateral distortion – or outward spread – of the peripheral edge 82 of canopy 16 under pressure. Lateral distortion of base frame 80 is, in turn, resisted by tie bars 80b, also shown in Figure 4A.

Figure 6A shows canopy 16 and its frame 82 as it is being lowered to the closed position on base 12 and base frame 80. Sealing strip 44 is fixed to the internal periphery of canopy frame 82 to move therewith and has an integral flap 100 attached by a thin neck 102. When canopy 16 is fully closed (Figure 6B) flap 100 rests against base 12 to form the desired hermetic seal and, as already noted, the outer face of canopy edge frame 82 fits inside edge strip 80a of base frame 80 to give it lateral support.

Figure 7 is a sectional view illustrating one way in which the internal and external actuator handles 56 and 54 may be arranged on the common shaft 84c in a manner that maintains the desired hermetic seal of canopy-to-base of the

capsule. An open-ended bearing tube 98 is moulded into the side of base 12 to house the corresponding end of shaft 84c, the inner end of tube 98 being fitted with a C-clip 104. The central periphery of tube 98 is slotted at 105 to accommodate handle 56 and allow the handle to be moved through a sufficient angle to permit operation of catches 50. With shaft 84c in place (ie, passing through) tube 98, an inner bearing 106 for shaft 84c is pushed into tube 98 along shaft 84c until it abuts C-clip 104, bearing 106 being fitted with a pair of inner O-rings 108 to sealingly engage shaft 84c and an outer pair of O-rings 110 to engage the bore of tube 98. Next, a hub 112 is pushed along shaft 84c into tube 104 until it abuts bearing 106, hub 112 being cross-drilled and threaded to take a corresponding screw-thread formed on the end 56a of handle 56. Hub 112 has an O-ring 114 on each side of handle end 56a to engage the bore of tube 104. An outer bearing 116 that is substantially the same as inner bearing 106 (including inner an outer O-rings) is then pushed into tube 104 along shaft 84c and the two bearings and hub are held in place by an outer C-clip 118. Finally, outer handle 54 is fitted to the outer end of shaft 84c by cross-pin 120 and inner handle 56 is screwed into hub 106 and into a depression formed in shaft 84c to ensure that handle 56 can rotate shaft 84c. It will be seen that, while shaft 84c is located outside the pressurized portion of capsule 10 and handle 56 is located inside, air cannot escape past the handle 56 out of tube 104 or along shaft 84c.

The pressurization, control and monitoring of the capsule of this example will now be described. In this example independent control and monitoring of the pressure, oxygen concentration (and/or CO₂ concentration), humidity and temperature of air in the capsule is provided. The need to be able to set the desired pressure in a hyperbaric chamber is, of course, obvious. However, the need to monitor for temperature, CO₂ and humidity is dictated by the fact that these variables can quickly rise to uncomfortable – even dangerous – levels in a capsule of small volume like that of the chosen example. If supplemental oxygenation is not used, oxygen monitoring is needed to (i) ensure that the oxygen concentration of air in the capsule does not fall significantly below that of the atmosphere and (ii) to generate an alarm in the event that it rises excessively. When supplemental oxygenation is used, it may be via a mask or via oxygen injection into the pressurizing air. In that case, it is desirable to have a separate indicator of mask

oxygen concentration, and the readings of CO₂ or oxygen concentration in the capsule air may then be of little significance. Control of pressure, temperature and humidity can be achieved by known air-conditioning techniques and apparatus, except for the need for an air pump or blower of higher than normal pressure.

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Figure 8 illustrates the basic arrangement of indicators and controls for the chosen example. An external set of indicators and controls is shown at 120 on the side of upright base 32 of capsule 10. Internally, a set of indicators (comprising meters and alarms) is mounted in box 122 located at the bottom front of canopy 16 so as to face a seated user. A set of controls 124 is mounted on the inside of one of canopy panels 20 so as to be convenient for operation by the user. The internal and external indicators and controls can duplicate one another. Cooled air is supplied to the interior of capsule 10 via a pipe 126 from an air-conditioning and pump unit 128 located at the bottom of the rear of base 12. Ideally, unit 128 can be controlled to vary air flow, relative humidity and temperature. The air inlet into the chamber comprises slots 72 (see also Figure 3) located above the back of chair 14 and the air exhaust valve 74 and outlet 130. Pressure regulation is achieved by varying the relative rate at which air flows into and out of the chamber. This may be done by the use of a fixed air outflow rate and a variable air supply rate, a fixed inflow rate and a variable outflow rate, or by a combination of these methods. A controller unit 134, which accepts inputs from the sensors of monitoring unit 122 and user controls 124, is shown located under the seat of chair 14. Figure 8 also shows an oxygen bottle 136 located in the back of base 12, though no connections are shown to it. Oxygen from this bottle may be used to inject supplemental oxygen into the input air in pipe 126 or it may be used to provide oxygen to a mask (not shown).

If desired, provision may be made for automatic depressurization and latch release in the event of power failure or excessive chamber air temperature, humidity or CO₂ concentration. Excessive CO₂ concentration and/or temperature can arise where air flow is too low due to malfunction or power failure and may not be noticed by the user in time to take remedial action. In this example, this safety feature is provided by:

manually withdraw bolt 144 but there will be little resistance to this since the chamber is under no pressure.

It will be appreciated that, though the example described above has many advantages over the prior art, many other examples of the invention – and many variations to the described example – are possible without departing from the scope of the invention as outlined above.

Two variations of the latching mechanism are shown in Figures 10 and 11 respectively. In the variant of Figure 10, canopy frame 82 carries two sliding notched latch plates 150a and 150b (on each side of the canopy) that engage respective rows of latch pins 152a and 152b located on each side of base frame 80. The sliding plates 150a on the bottom edge of canopy 82 are moved backwards and forwards by an actuator lever 154 and are coupled (by means not shown) to upper sliding plates 150b so that all plates move in unison to engage and disengage latch pins 152a and 152b. Figure 10A shows the frames in the open position and Figure 10B shows the frames in the closed position.

The second variant, shown in Figures 11 and 11B, has mushroom-headed latch pins 160 depending from the bottom of canopy frame 82 adapted to be engaged by with keyhole slots 162 in reciprocating plates 164 that are fixed to a carrier plate 166, which is in turn fixed to the base frame (not shown). Plates 164 are reciprocated by a rack and pinion mechanism 168 that is operated by an actuator lever 170. Figure 11A shows a latch pin 160 engaged with a slot 162 when the canopy (not shown) is in the closed position and latch plates 164 are in the locked position. Figure 11B shows canopy frame 82 removed a little way from the base frame with latch plates 164 in the open or release position.

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- (i) ensuring that power failure or the operation of the CO₂ alarm will deactivate air-conditioning and pump unit 128 and open inlet pipe 126 to atmosphere,
- (ii) fully open exhaust valve 74, if it is controllable (air will still exhaust from the chamber if valve is not controllable), and
- (iii) operate an automatic latch actuator unit 140 that is located in back 32 of base 12 and connected to shaft 84c.

Thus, as soon as the pressure within capsule 10 is equilibrated with atmospheric, the latches will be opened and struts 24 will pop the canopy open enough to ensure circulation of ambient air through the chamber.

Desirably, the CO₂ sensor, controller 134 and automatic actuator 140 should have sufficient standby battery power to operate in the event of power failure. However, the power requirement of actuator 140 may be too large for the standby battery suited to the sensors and controller, so spring, pneumatic or other energy storage means can be used to power unit 140.

A further safety feature envisaged for the chosen example is a pressure operated interlock that will prevent the canopy from being opened prematurely by the user. This may result in forceful and dangerous opening of the canopy if the user has sufficient strength to force internal handle 56 and release latches 50. A suitable safety interlock, located in canopy frame 82, is shown in Figures 9A and 9B. The interlock simply comprises a diaphragm 142 mounted in frame 82 that carries a slide-bolt 144 which is moved outwards to engage a catch-plate 146 that is fixed to base frame 80. A spring 148 biases bolt 144 away from catch-plate 146 so that, if the chamber pressure approximates ambient air pressure, the capsule can be opened normally and without the need to touch bolt 144. On the other hand, if the chamber pressure is significantly higher than ambient, and if handle 56 is forced to prematurely open catches 50, the interaction of bolt 144 and catch-plate 146 will prevent the canopy from opening more than enough to ensure immediate pressure equalization. To fully open the canopy after operation of the latches in this way, where bolt 144 is still extended, it may be necessary for the user to

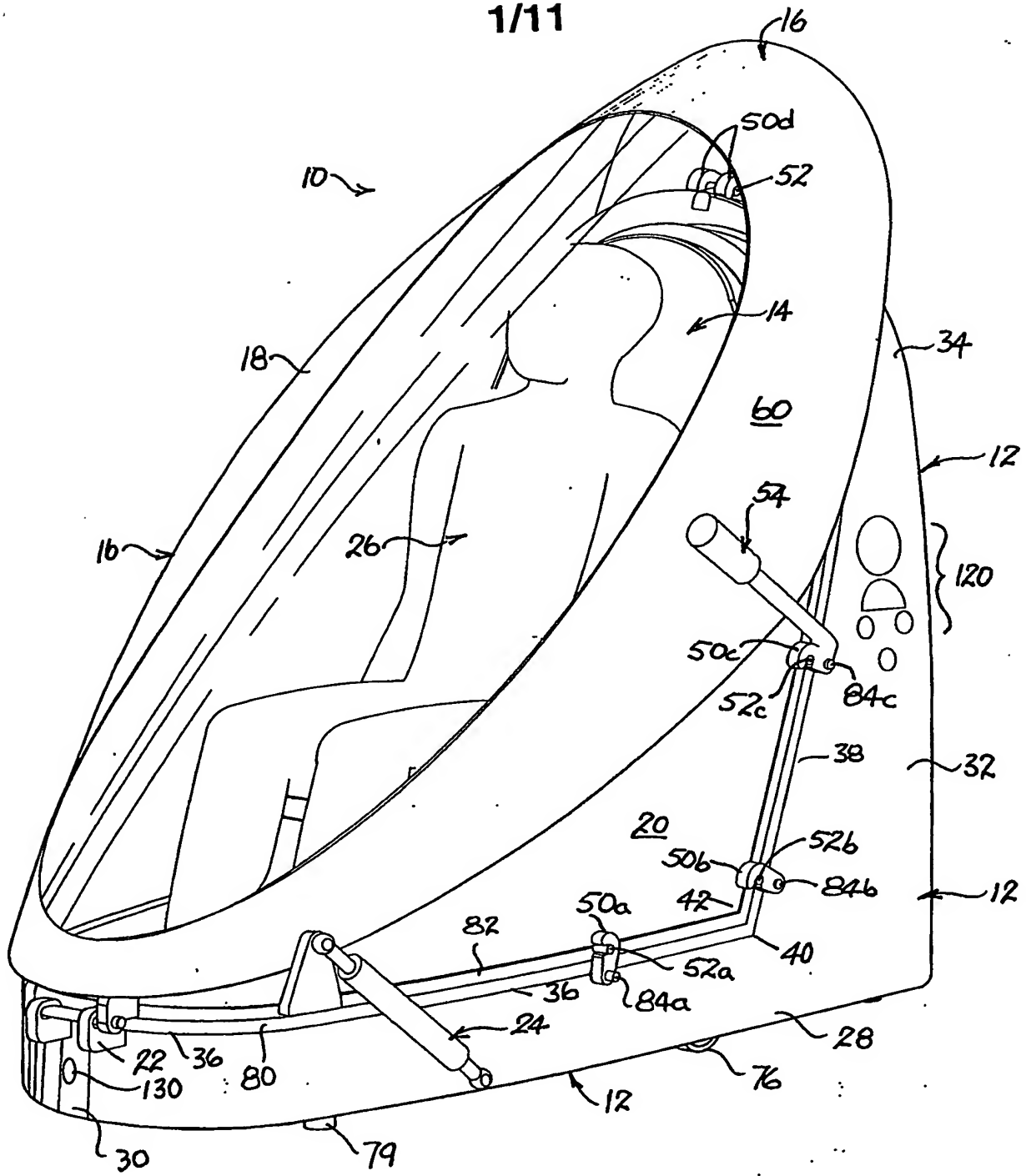


Fig.1

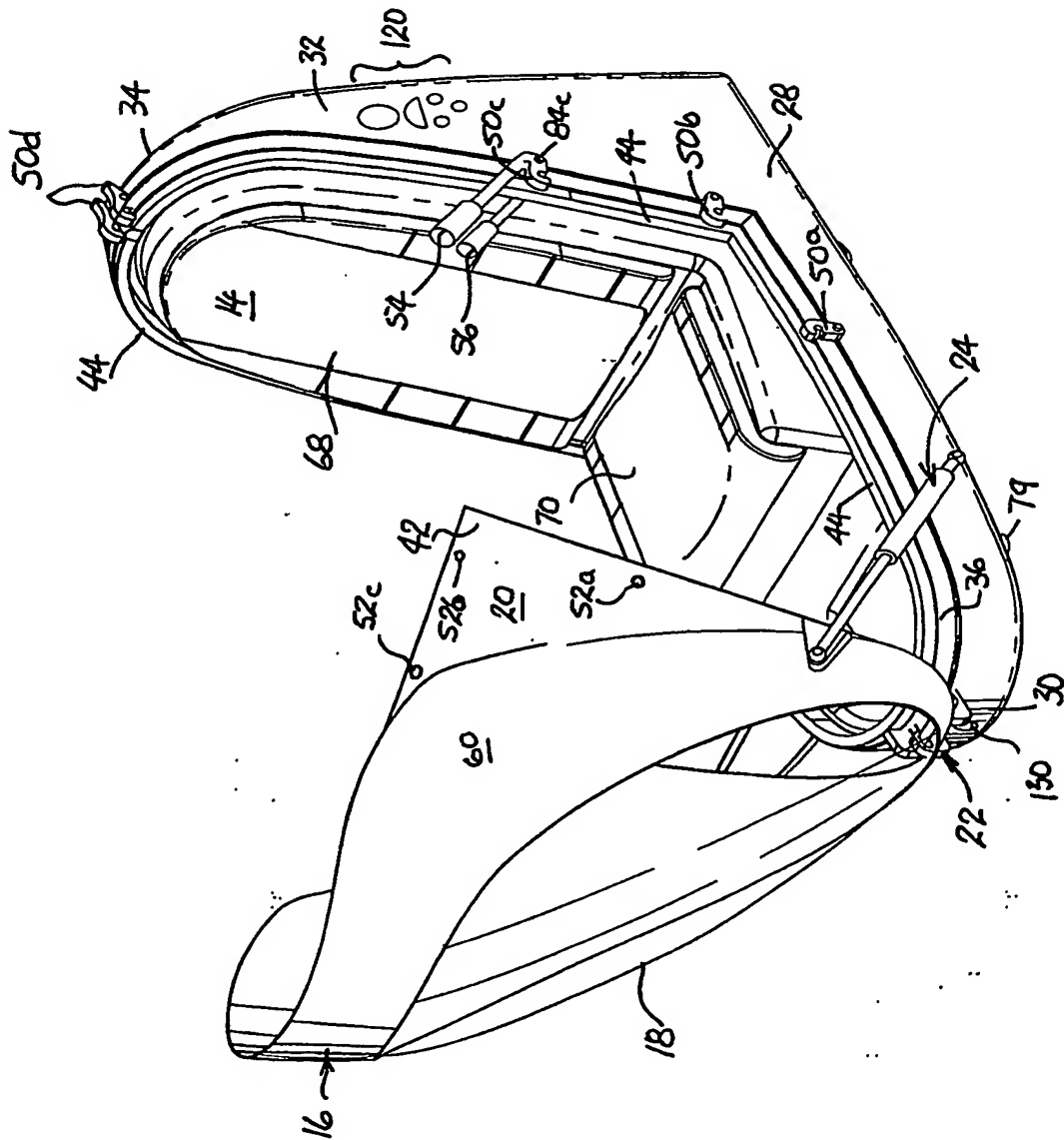


Fig.2

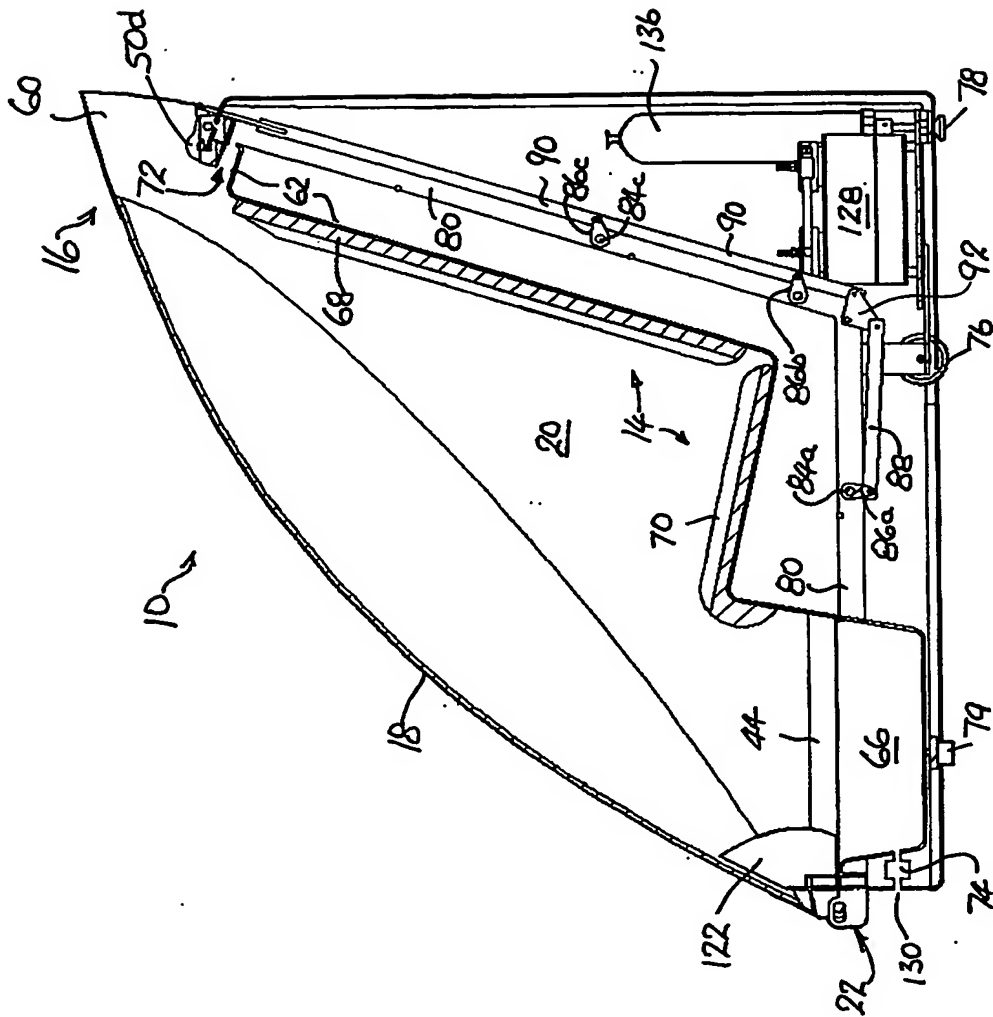


Fig. 3

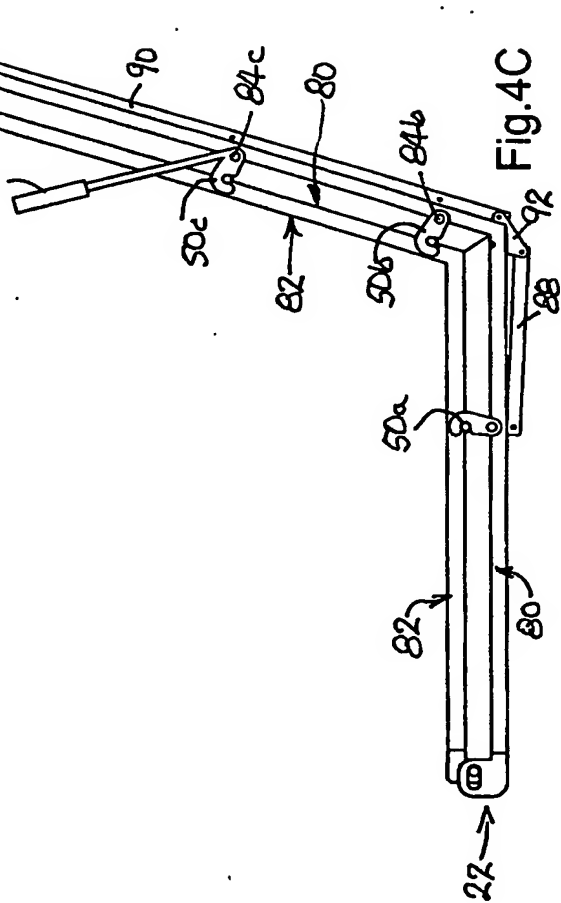
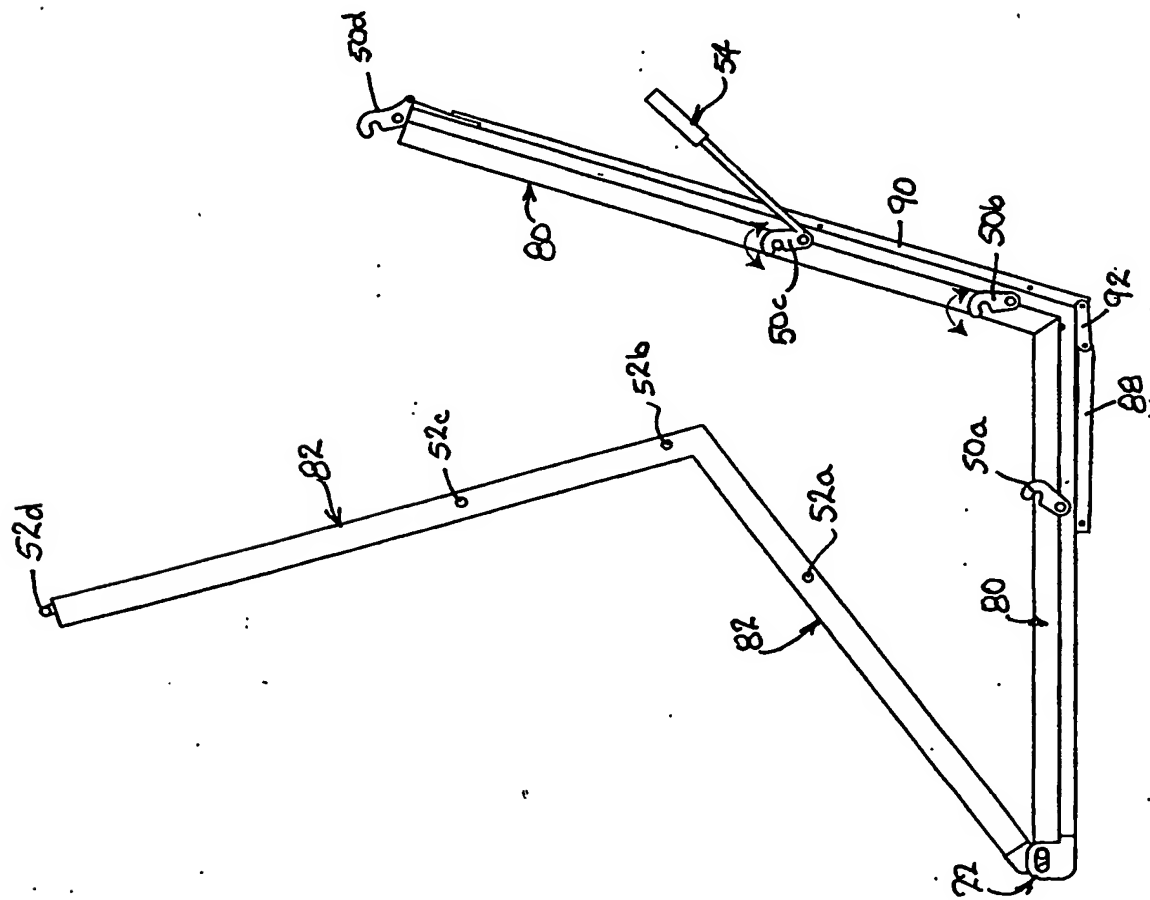
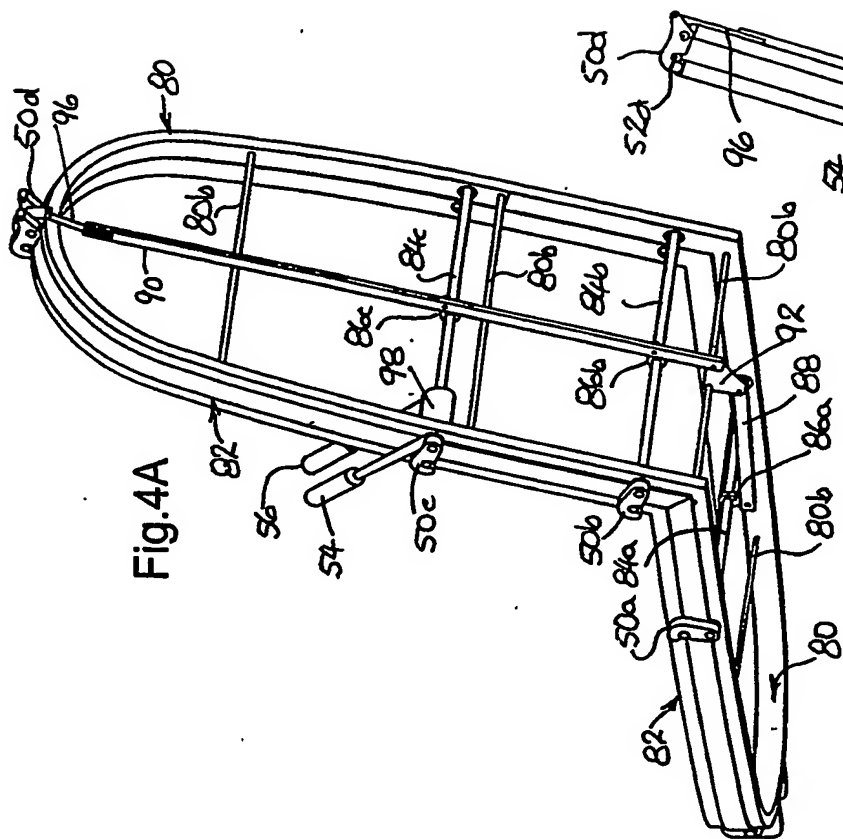


Fig.5A

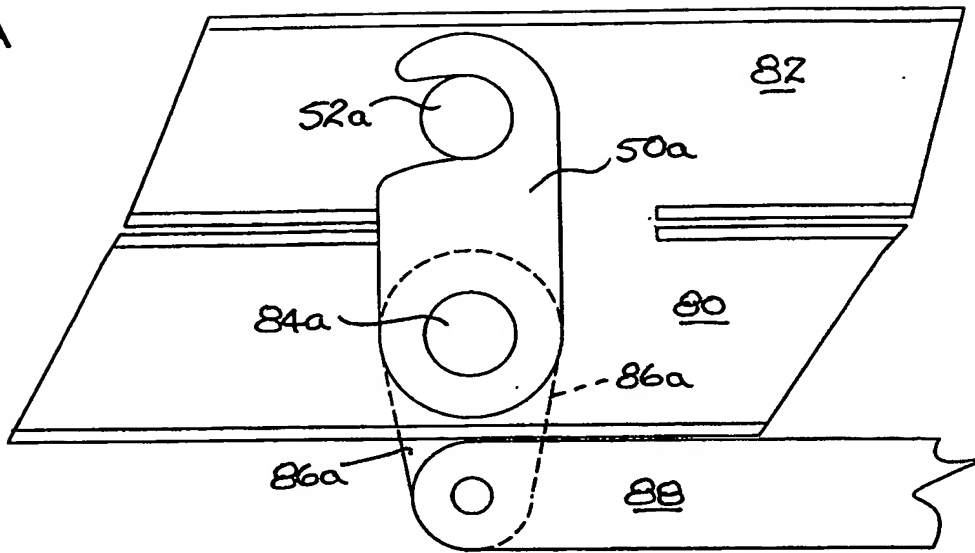


Fig.5B

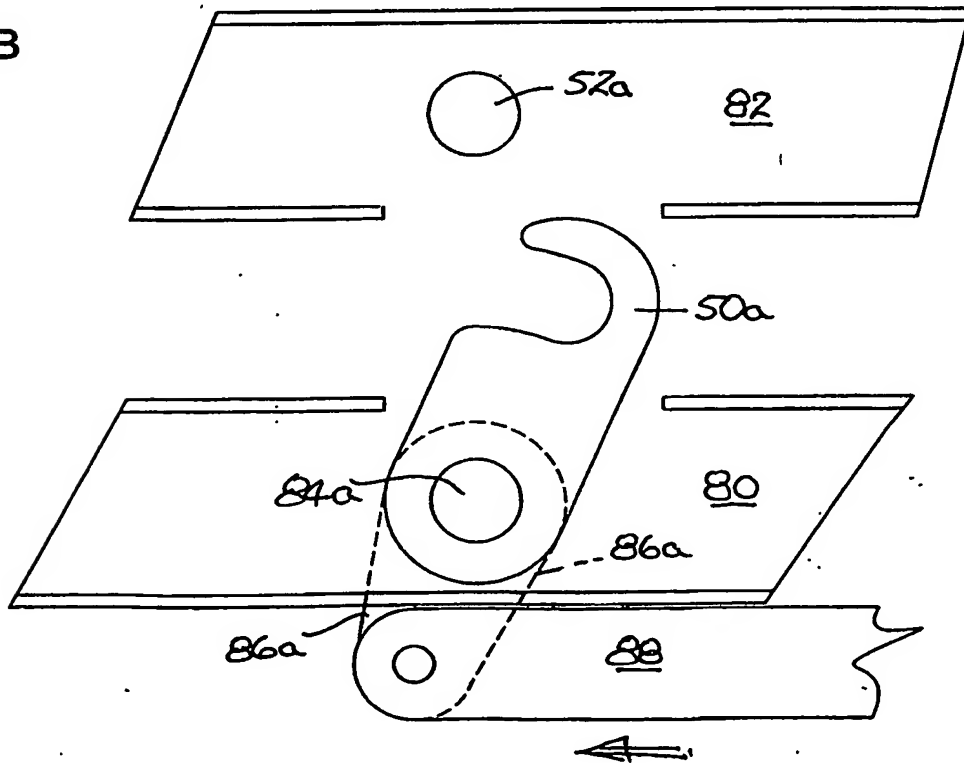


Fig.6B

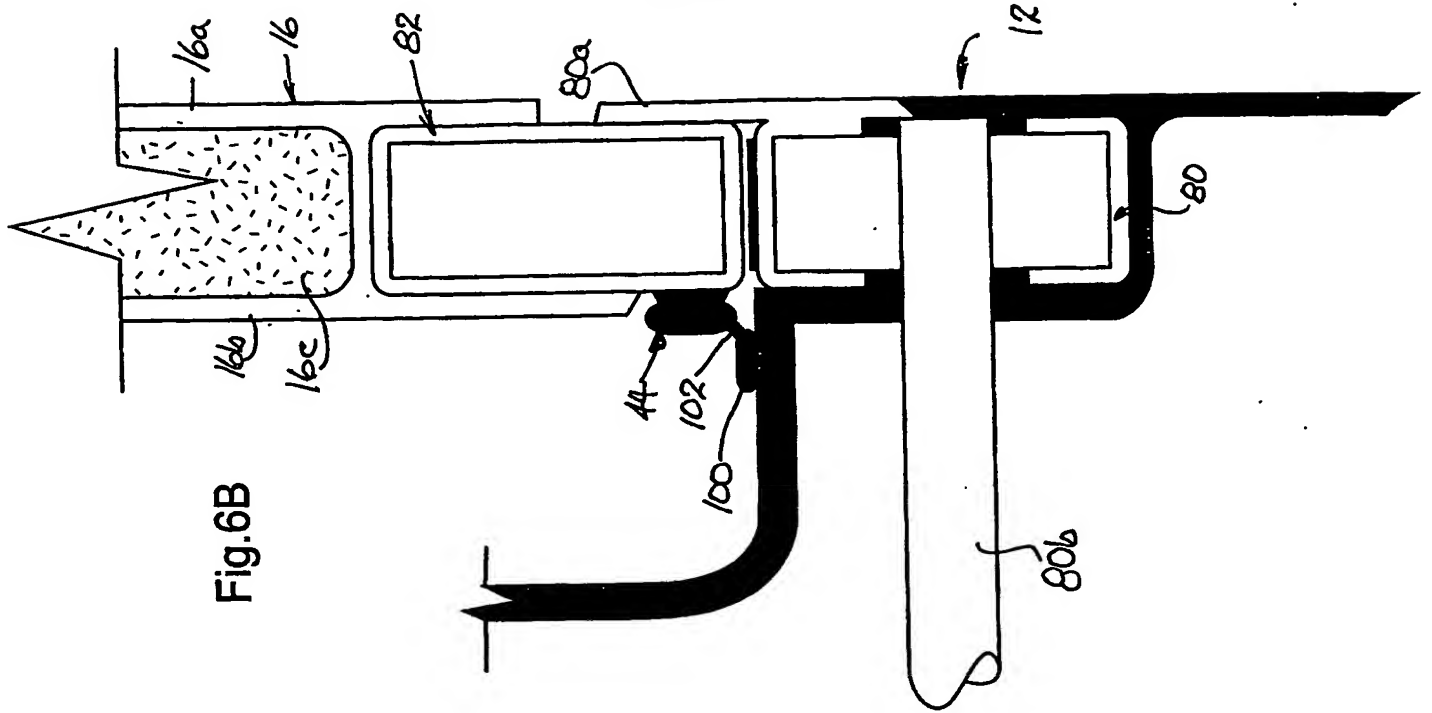
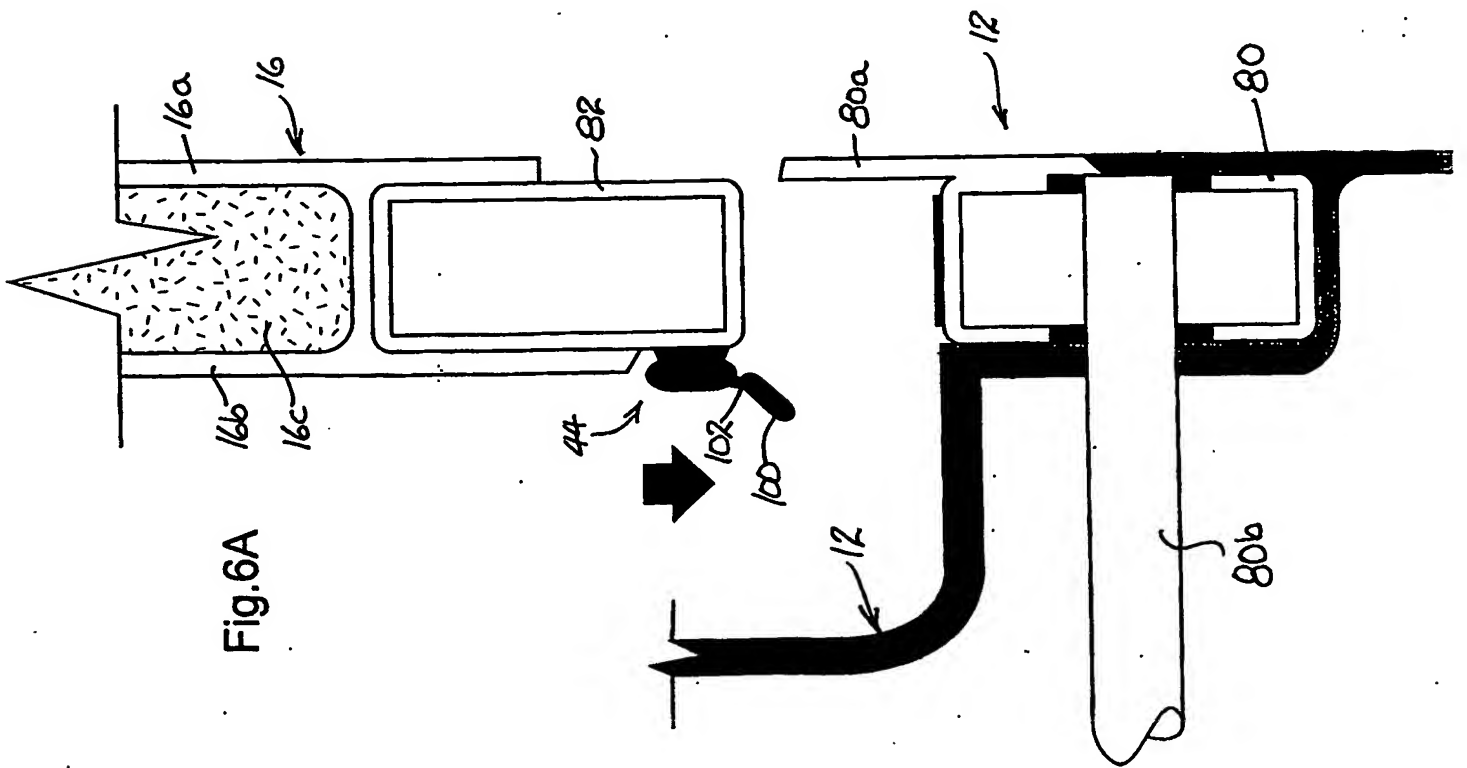


Fig.6A



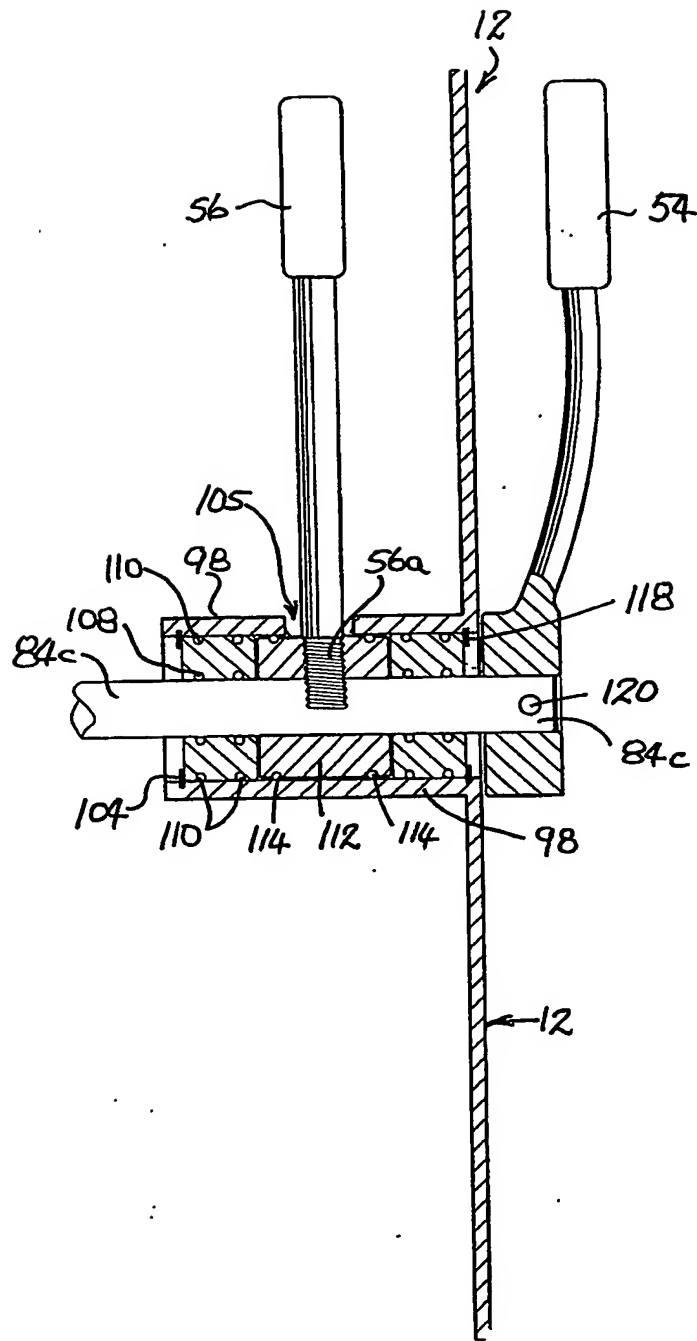


Fig.7

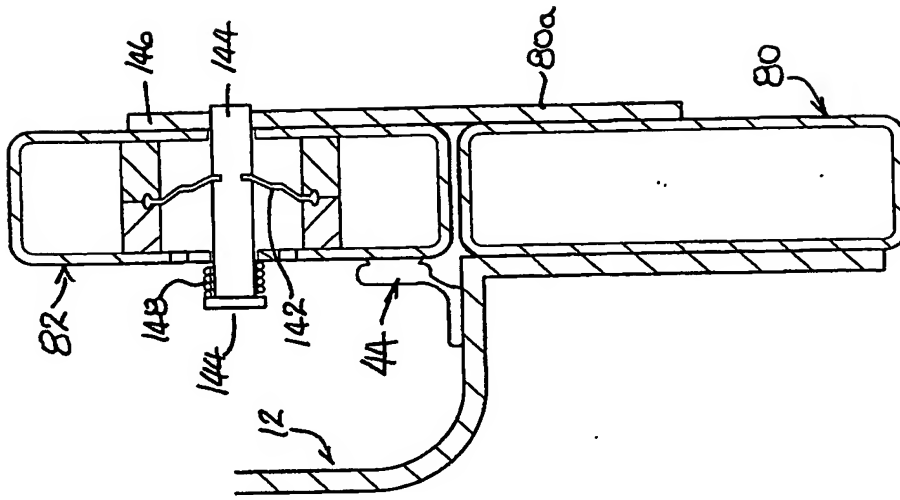


Fig.9B

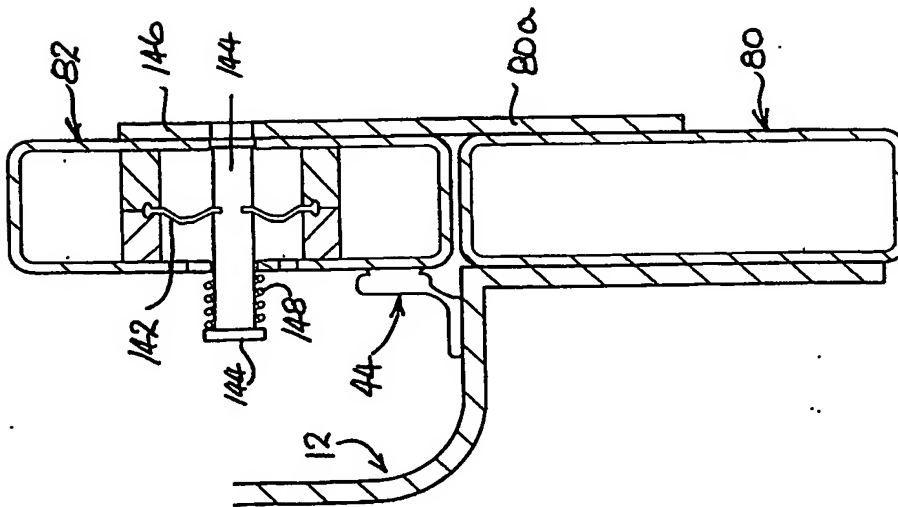


Fig.9A

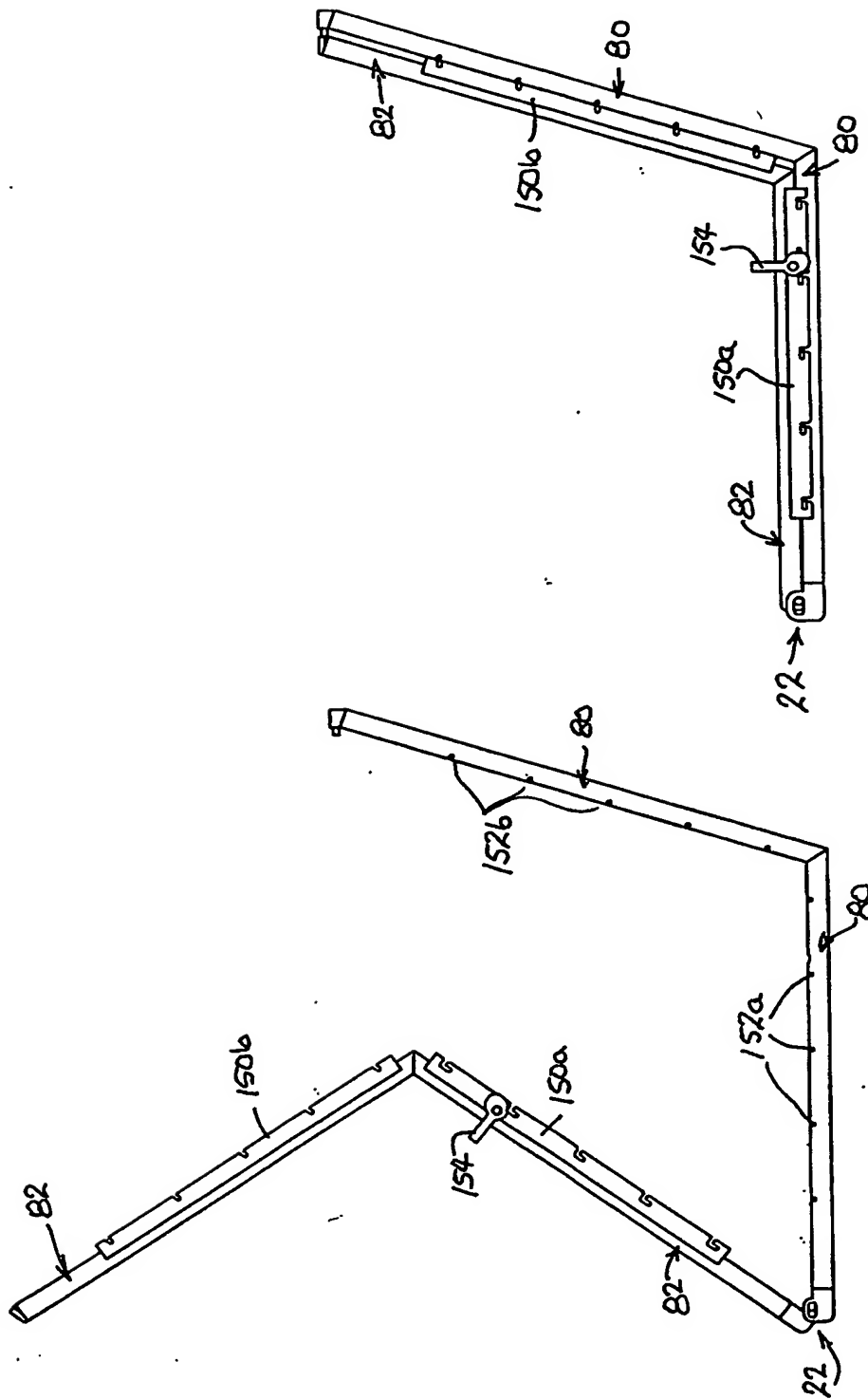


Fig.10B

Fig.10A

Fig.11B

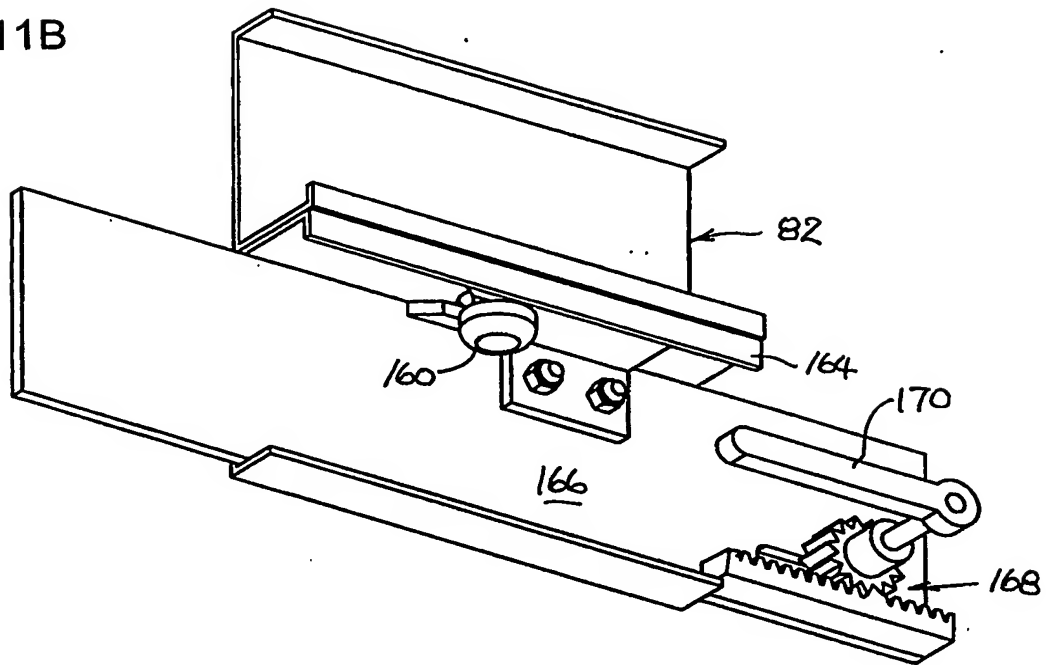
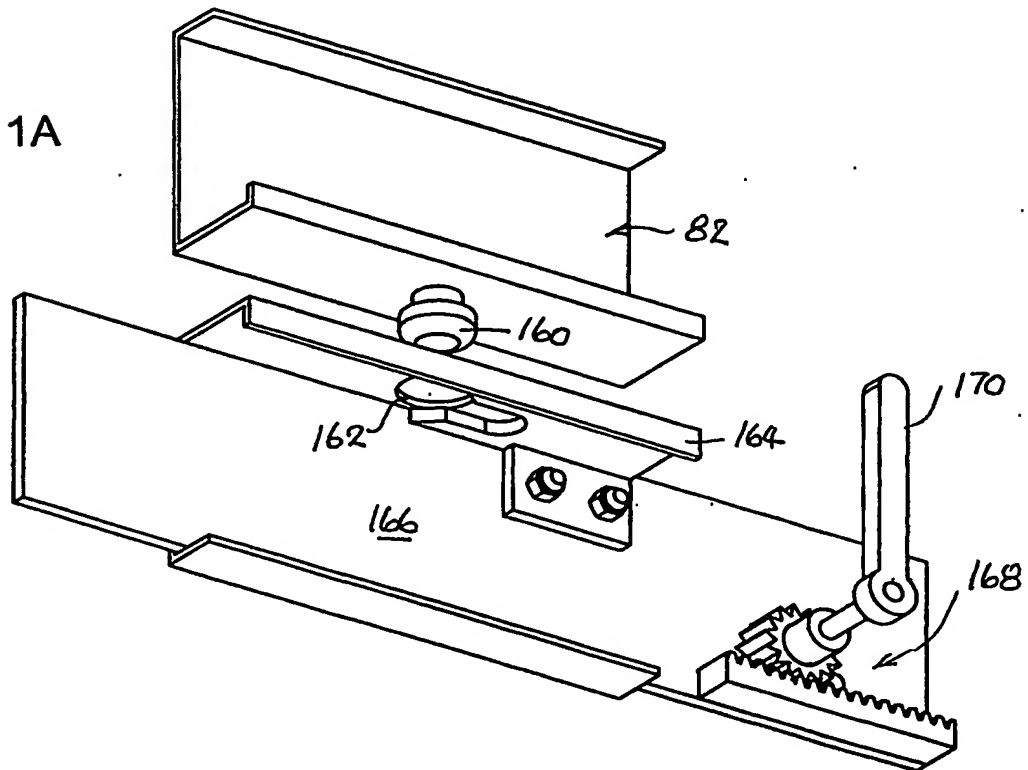


Fig.11A



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